

SHORT NOTE

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Lanternfish (Myctophidae) in the diet of the Cape petrel *Daption capense* at the South Shetland and South Orkney Islands, Antarctica

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Abstract All of the fish identified in stomach contents and regurgitations of breeding and chick Cape petrels collected during January and February 1996 at Fildes Peninsula and Harmony Point, both in the South Shetland Islands and at Laurie Island, South Orkney Islands, were myctophids, a family never previously reported in the diet of breeding Cape petrels. *Electrona antarctica* was the most important fish prey, followed by *Electrona carlsbergi* at Fildes Peninsula, *Krefftichthys anderssoni* at Harmony Point and *Gymnoscopelus braueri* at Laurie Island. The absence of *Pleuragramma antarcticum* in the diet of this petrel, which is considered a *P. antarcticum*-feeder, is discussed.

Introduction

Several studies carried out in Antarctic and sub-Antarctic areas reported the presence of fish in the diet of the Cape petrel (*Daption capense*). Some of these studies do not provide information on the fish species eaten (Ridoux and Offredo 1989; Ridoux 1994), although Green (1986) identified *Pagothenia borchgrevinki* and *Trematomus* sp., and Beck (1969), Arnould and Whitehead (1991), van Franeker and Williams (1992) and Creet et al. (1994) indicated that *Pleuragramma antarcticum* was the only fish represented in the samples. Soave et al. (1996) and Coria et al. (1997) observed that fish were the main prey of *D. capense* but, surprisingly, all of the species identified were myctophids, a group never previously reported in the diet of breeding Cape petrels. Thus, the aim of this study was to provide further information on the fish observed by these authors in the

diet of breeders and chicks of this bird at the South Shetland and South Orkney Islands.

Materials and methods

The study was carried out in January and February 1996 at Fildes Peninsula (62°12'S, 58°58'W), King George Island, and at Harmony Point (62°18'S, 59°14'W), Nelson Island, both in the South Shetland Islands, and at Laurie Island (60°46'S, 44°42'W), South Orkney Islands.

The diet of breeders was studied by the analysis of stomach contents obtained by the water off-loading method (Wilson 1984) when the birds returned from foraging trips to feed the chicks. As soon as disturbed, the petrels regurgitated oil and food, which was then collected in polythene bags tied to the neck of a funnel held below the bill of the bird and pooled with the corresponding stomach content. During post-brooding we also obtained stomach contents and regurgitations from chicks older than 20 days. The procedure followed to obtain and process this material is explained in detail in Soave et al. (1996) and Coria et al. (1997). The sample size is shown in Table 1.

The otoliths recovered from the samples were assigned to species using illustrations and descriptions in Hecht (1987) and Williams and McEldowney (1990). The otoliths belonging to each species were sorted into right and left, the most abundant being considered as the number of individuals from that species present in the sample. The length and mass of the individuals identified were estimated from otoliths length (OL) using the equations in Hecht (1987) and Williams and McEldowney (1990).

Results

Fish, followed by krill, predominated in the diet of adults and chicks at Harmony Point and Laurie Island, whereas

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Table 1 Detail of the number of samples obtained during January and February 1996 at Fildes Peninsula and Harmony Point, South Shetland Islands and at Laurie Island, South Orkney Islands

	Adult stomach contents	Chick stomach contents	Chick regurgitations
Fildes Peninsula	17	12	8
Harmony Point	20	—	18
Laurie Island	32	—	40

at Fildes Peninsula the relationship was inverse with krill as the main prey. Secondary prey were amphipods (gammarids and hyperids) and octopods; for more details see Soave et al. (1996) and Coria et al. (1997).

Thirty-nine fish were represented by the otoliths recovered at Fildes Peninsula; 34 of them were identified as *Electrona antarctica*, *Electrona carlsbergi*, *Gymnoscopelus braueri*, *Krefftichthys anderssoni* and *Protomyctophum bolini* and 5 individuals remained unidentified. *Electrona carlsbergi* slightly predominated by mass in the adult stomach contents whereas *E. antarctica* predominated in samples from chicks (Table 2).

The otoliths obtained at Harmony Point represented 24 fish; 14 of them were identified as *E. antarctica* and *K. anderssoni*. *Electrona antarctica* was the only fish iden-

tified in adults' samples and dominated by mass in those from chicks (Table 3).

One hundred and nine fish were represented by the otoliths obtained at Laurie Island; 95 were identified as *E. antarctica*, *G. braueri*, *K. anderssoni*, *Gymnoscopelus nicholsi* and *Gymnoscopelus opisthopterus*. *Electrona antarctica* predominated in adult and chick samples whereas *K. anderssoni* and *G. opisthopterus* were only represented in samples from adults and *G. nicholsi* in those from chicks. (Table 4).

Discussion

Fish were an important component in the diet of adult and chick Cape petrels at the three sampling sites and were the main prey at Harmony Point (Soave et al. 1996) and at Laurie Island (Coria et al. 1997). All of the fish identified were myctophids and among them *E. antarctica* was the most important prey.

Arnould and Whitehead (1991) and van Franeker and Williams (1992) observed at Prydz Bay and at the Windmill Islands that *Pleuragramma antarcticum* was the only fish found in stomach contents of Cape petrels.

Table 2 Fish represented in the diet of Cape petrels (*Daption capense*) as reflected by the analysis of stomach contents and regurgitations collected during January and February 1996 at Fildes Peninsula, South Shetland Islands. Frequency of occurrence per

cent (*F%*), importance by number per cent (*N%*) and importance by mass per cent (*M%*); mean length ($\pm$ standard deviation) and size range in millimeters

	F%	N%	M%	Mean length	Size range
Adults (<i>n</i> = 17)					
<i>Electrona antarctica</i> ^a	83.3	64.3	49.0	52.8 $\pm$ 9.2	41.0–70.8
<i>Electrona carlsbergi</i> ^b	33.3	21.4	51.0	88.9 $\pm$ 5.2	85.1–96.1
Unidentified	16.7	14.3	—	—	—
Chicks (<i>n</i> = 20)					
<i>E. antarctica</i> ^a	90.0	68.0	65.7	52.9 $\pm$ 11.9	33.5–68.9
<i>Gymnoscopelus braueri</i> ^a	10.0	4.0	13.4	89.3	—
<i>Krefftichthys anderssoni</i> ^b	10.0	4.0	12.4	95.7	—
<i>Protomyctophum bolini</i> ^b	10.0	12.0	8.6	22.1 $\pm$ 2.3	20.2–25.3
Unidentified	30.0	12.0	—	—	—

^a Length in standard length

^b Length in total length

Table 3 Fish represented in the diet of Cape petrels (*Daption capense*) as reflected by the analysis of stomach contents and regurgitations collected during January and February 1996 at Harmony Point, South Shetland Islands. Frequency of occurrence per cent

(*F%*), importance by number per cent (*N%*) and importance by mass per cent (*M%*); mean length ($\pm$ standard deviation) and size range in millimeters

	F%	N%	M%	Mean length	Size range
Adults (<i>n</i> = 20)					
<i>Electrona antarctica</i> ^a	87.5	61.5	100.0	64.7 $\pm$ 5.9	55.5–71.5
Unidentified	37.5	38.5	—	—	—
Chicks (<i>n</i> = 18)					
<i>E. antarctica</i> ^a	100.0	45.5	60.7	54.2 $\pm$ 7.7	41.7–65.5
<i>Krefftichthys anderssoni</i> ^b	50.0	9.1	39.3	96.6	—
Unidentified	50.0	45.5	—	—	—

^a Length in standard length

^b Length in total length

Table 4 Fish represented in the diet of Cape petrels (*Daption capense*) as reflected by the analysis of stomach contents and regurgitations collected during January and February 1996 at Laurie Island, South Orkney Islands. Frequency of occurrence per cent (*F%*), importance by number per cent (*N%*) and importance by mass per cent (*M%*); mean length ($\pm$ standard deviation) and size range in millimeters

	F%	N%	M%	Mean length	Size range
Adults (<i>n</i> = 32)					
<i>Electrona antarctica</i> ^a	100.0	71.9	52.6	62.0 $\pm$ 8.1	36.0–76.9
<i>Gymnoscopelus braueri</i> ^a	23.8	9.4	23.3	99.9 $\pm$ 15.2	78.4–126.9
<i>Krefftichthys anderssoni</i> ^b	19.1	7.8	14.6	110.3 $\pm$ 11.3	97.4–127.7
<i>Gymnoscopelus opisthopterus</i> ^a	4.8	1.6	9.5	137.2	–
Unidentified	19.1	9.4	–	–	–
Chicks (<i>n</i> = 40)					
<i>E. antarctica</i> ^a	85.7	77.8	73.6	61.3 $\pm$ 6.6	45.6–71.9
<i>Gymnoscopelus nicholsi</i> ^b	4.8	2.2	21.4	170.9	–
<i>G. braueri</i> ^a	4.8	2.2	5.1	88.0	–
Unidentified	23.8	17.8	–	–	–

^a Length in standard length

^b Length in total length

Two previous studies have analysed the diet of this petrel at the archipelagos considered here. Beck (1969) commented that, although not positively identified, the eye lenses and vertebrae present in samples from the South Orkney Islands probably belonged to *Pleuragramma antarcticum*. Creet et al. (1994) reported that almost all the fish remains found in stomach contents collected at Admiralty Bay, South Shetland Islands, were identified directly and that all of them belonged to *Pleuragramma antarcticum*. However, as the size of these fish was estimated from otolith lengths it is probable that the specimens were not entire but digested, so that the character used for their identification was not definite. Interestingly, *Pleuragramma antarcticum* was absent in our samples from the South Orkney and South Shetland Islands, being replaced by myctophids, a fish group never previously reported as prey of breeding Cape petrels. Casaux et al. (1997) reported a similar finding in the Weddell seal, also considered a *Pleuragramma antarcticum*-feeder, at Harmony Point during the summer of 1996. W. Trivelpiece (personal communication) observed that the occurrence of *Pleuragramma antarcticum* in the diet of the South Polar skua at Admiralty Bay was highly variable between years and that the proportion of myctophids appears to have increased since the late 1980s. If it is assumed that at these two archipelagos *Pleuragramma antarcticum* is the main prey of the Cape petrel and that the specimens in the studies of Beck (1969) and Creet et al. (1994) were correctly identified, we must conclude that the abundance of this fish within the Cape petrels' foraging areas at the South Orkney and South Shetland Islands fluctuates greatly between years, showing a peak in scarcity in the summer of 1996. However, if Cape petrels positively select smaller fish preys, as suggested by the occurrence of the fish ingested (see Tables 2, 3, 4), we should expect a poor representation of *Pleuragramma antarcticum* in the diet when myctophids (mainly *E. antarctica*) are abundant.

Unfortunately, there is no information on the abundance of *Pleuragramma antarcticum* and myctophids around the archipelagos considered here. Studies aimed at understanding the foraging strategies of Cape petrels, as well as the fluctuations in the abundance of pelagic

fish at the South Shetland and South Orkney Islands, are thus required.

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